DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

SURFICIAL MATERIALS DATA AND QUATERNARY GEOLOGIC HISTORY OF THE BROAD BROOK QUADRANGLE, CONNECTICUT

BY

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DESCRIPTION OF GEOLOGIC UNITS

71-74

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TO BE USED WITH
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SHEET 1 OF 2

Map symbol	Geologic unit	Description and occurrence	Origin	Drainage and permeability	Ease of excavation	Slope stability	Foundation conditions [1]	Frost heave susceptibility	Erosion susceptibility	Unified soil classification [2]	Use	Materials test data [3]
af	Artificial fill	Earth fill consisting of sand, gravel, and till. Reddish brown where till was source. Generally less than 20 feet thick but as much as 40 feet thick. Poorly sorted, loose to compact, generally well compacted. In highway and railroad embankments, earth dams, and other fills. Not mapped where less than 5 feet thick.	Manmade. Material mostly taken from dune deposits, ice-contact stratified drift, and, to a lesser extent, from till hills.	Surface well drained. Permeability generally low in fills of well-compacted till; high in fills of sand.	Easy with hand and power machinery.	Depends on degree of compaction and on how soon slopes are grassed over. Connecticut State Highway specifications call for 2:1 slopes.	Fair to good.	Depends on percent of clay, silt, and moisture content.	Variable		Subgrade. Base course.	See: sand dunes and other eolian deposits, till, and ice-contact stratified drift.
Qal	Alluvium	Silt, sand, clay, and gravel. Light grayish brown (5 YR 5/4) [4]. As much as 40 feet thick but generally 20 feet thick. Locally very coarse gravel. Moderately well to well bedded, laminated to thin bedded, discontinuous to lenticular, and crossbedded. Poorly compacted. Locally-organic content high. Underlies river and stream beds and flood plains. Boulder alluvium downstream from Warehouse Point. Local relief rarely exceeds 15 feet. Well exposed in cut banks along Connecticut and Scantic Rivers.	Derived from reworking of glacial deposits and erosion of bedrock. Deposited up to 40-foot contour (1936 flood) near expressway bridge (I-91).	Surface drainage good to poor. Permeability depends on proportions of clay, silt, and sand, but generally fair.	Very easy to moderately easy with hand tools and power machinery; difficult to excavate when wet or where percentage of clay is high.	Fair; high when dry, low when wet. Recommended slope 20° to 30°.	Good in sand and gravel, poor in saturated silt and clay. Difficult to compact, except where drainage can be improved. Not expansive.	Moderate to high.	Moderate to high.	SW ML GC	Suitable for fill. Generally unsatisfactory as a subbase for hard-surfaced roads; unsurfaced roads made of this material may be impassable [5] when wet.	Qal: 10: 3 clay, 20 silt, 77 sand, 0 granules, 0 pebbles; 18: 4, 56, 40, 0, 0; 20: 8, 40, 52, 0, 0; 27: 0, 2, 98, 0, 0; 30: 0, 4, 96, 0, 0; 32: 0, 2, 22, 3, 73; 37: 0, 1, 50, 13, 36
Qld	Landslide deposits	Involve varved lake deposits and various glacial deposits. Color depends on units involved. As much as 50 feet thick. Slopes range from steep to nearly flat. Plastic and poorly sorted.	Undercutting of cut banks of Connecticut and Scantic Rivers.	Numerous poorly drained depressions. Seepage springs common. High to low permeability.	Easy to difficult in both active and inactive landslides.	Poor, unstable. Recommended slope 10°.	Unsuitable.	Moderate to high.	High	CH	None. Should be avoided as building sites or roadways. Unwise to borrow for fill.	No test data.
Qsd	Sand dunes and other eolian deposits	Dunes, yellowish-brown (10 YR 6/4), nearly 100 percent sand; as much as 40 feet thick, 1,000 feet long, and 300 feet wide. In part well bedded; locally crossbedded. Veneer of unbedded eolian silt and sand, generally 3 feet thick, mantles most of area; moderate yellowish-brown (10 YR 5/4). Poorly compacted well-sorted, loose. Blanket of eolian sand 3 to 5 feet thick covers most of quadrangle (not mapped).	Lake, outwash, and alluvial deposits redeposited by wind.	Good to poor surface drainage. Permeability high.	Easy with hand tools and light and heavy power machinery.	Dune sand assumes angle of repose for dry sand (25° to 30°). Eolian silt stands in near vertical cuts for long periods. Recommended slope 25°.	Good, difficult to compact.	Low or negligible in sand. Frost heaving of silt depends on moisture available.	High	SM ML SP	Used for fill; source of medium to fine sand; fair subbase for hard-surfaced roads.	Qsd: 4: 0 clay, 5 silt, 95 sand; 12: 0, 2, 98; 13: 0, 3, 97; 19: 0, 3, 97
Qs	Swamp deposits	Peat, muck, silt, sand, and clay. Grayish-brown (5 YR 3/2). As much as 25 feet thick but generally 5 feet thick. Crudely bedded, poorly sorted, not compacted, very plastic. Contains siliceous diatoms and spores.	Deposited in ice-block holes, glacial scour basins, meander scars, and in poorly drained areas along streams.	Surface drainage poor; generally unintegrated. Subsurface drainage negligible.	Easy with power machinery. Difficult to excavate with hand tools.	Unstable if water table is lowered rapidly. With slow drainage will stand in 30° cuts several feet high.	Poor; difficult to compact.	Severe to moderate.	Slight	OH	Peat used on lawns and in gardens. Sold as "loam" or "peat moss."	Qs: 43: 5 clay, 57 silt, 38 sand; 44: 0, 88, 12. Organic content high (10 percent of No. 43 and 40 percent of No. 44 lost during ignition test).
Qst	Terrace deposits	Sand, silt, and clay; locally pebbly; well-sorted. Mainly yellowish-brown (10 YR 6/4). As much as 20 feet thick but generally 10 feet thick. Organic content low. Bedding lenticular to locally persistent; thin bedded, crossbedded, and poorly compacted to loose.	Deposited on surfaces cut by streams. All seem to be cut terraces.	Good surface drainage; moderate permeability.	Easy with hand tools and power machinery.	Fair; maximum vertical face observed was 15 feet at Windsor Locks sewer plant (1/4 mile W. of quadrangle)--stood unsupported for 2 months. Recommended slope 25°.	Good.	Low to high.	Moderate	SW	Suitable for use as fill. Unpaved roads in silty and clayey areas may be impassable [5] when wet.	Qst: 7: 0 clay, 2 silt, 98 sand, 0 granules, 0 pebbles, --- liquid limit, --- plastic limit, --- plasticity index; 15: 0, 6, 94, 0, 0, ---, ---, ---; 22: 0, 6, 45, 49, 0, ---, ---, ---; 31: 6, 20, 72, 1, 1, ---, ---, ---; 34: 0, 4, 86, 3, 7, ---, ---, ---; 40: 13, 37, 50, 0, 0, none, 16, none; 41: 9, 60, 31, 0, 0, ---, ---, ---; 42: 2, 55, 43, 0, 0, ---, ---, ---
Qo	Outwash	Sand and gravel, locally very coarse. Pale brown (5 YR 5/4). As much as 20 feet thick but generally less than 10 feet. Well to poorly sorted. Loose, well to poorly bedded.	Deposited in temporary channels and outwash plains by glacial melt water carrying sand and gravel.	Good to poor surface drainage; permeability high.	Easy with hand tools and power machinery except where cobbles and boulders are present.	Low; vertical cuts slump rapidly until angle of repose (25° to 30°) for coarse sand and gravel is reached.	Good.	High, owing to generally high water table.	Low	GW	Source of sand and gravel. Makes good subbase for roads. Source of aggregate.	No test data.
Qcd	Ice-contact stratified drift undifferentiated	Sand and gravel. Reddish-brown (10 R 4/4), pale yellowish-brown (10 YR 5/4) to grayish-orange pink (5 YR 7/2). As much as 70 feet thick but generally less than 35 feet thick. Well to poorly sorted. Locally cemented by calcium carbonate. Well to poorly bedded; much crossbedding. Bedding tilted and locally contorted; numerous minor faults. Well to poorly compacted. Contains flow till 8 feet thick.	Laid down on and against glacial ice by melt waters which fluctuated rapidly in volume, velocity and direction. Collapse of deposit followed melting of supporting ice.	Generally well drained except for local kettles which contain swamps or ponds. Permeability generally high.	Easy with hand tools and power machinery; large boulders may require special handling.	Poor; vertical cuts slump rapidly until natural angle of repose (25° to 30°) for coarse sand and gravel is reached.	Good.	Low	Moderate to low.	SM SP	Source of sand and gravel for fill, subbase, coarse base, and aggregate for concrete. Careful prospecting necessary. Good subbase for surfaced roads; unsurfaced roads generally passable [5] in wet weather.	Qcd: 6: 2 clay, 12 silt, 37 sand, 12 granules, 37 pebbles, 0 cobbles; 8: 0, 22, 78, 0, 0, 0; 9: 0, 2, 74, 7, 17, 0; 17: 1, 11, 56, 6, 25, 1; 21: 0, 2, 98, 0, 0, 0; 23: 0, 4, 27, 6, 50, 13; 24: 0, 2, 35, 7, 53, 3; 33: 1, 14, 50, 3, 30, 2; 35: 0, 1, 69, 2, 25, 3; 36: 0, 5, 24, 8, 62, 1
Qb	Beach deposits	Sand, silt, and shingle gravel. Reddish-brown (10 R 4/4). As much as 20 feet thick but generally 10 feet. Well to poorly sorted; some openwork gravel. Bedding discontinuous, thin to thick, and crossbedded. Crudely to well-stratified; overlies and interfingers with lake deposits.	Formed by wave action along shore of a glacial lake and on sides of drumlins.	Good surface drainage; high permeability.	Easy with hand tools and power machinery.	Fair, but slopes soon slump and ravel to the angle of repose for sand (30° to 35°).	Good to poor; if immediately underlain by varved clay subsidence may occur.	Low	Moderate	ML GM	Source of aggregate and fill. Good to fair subbase for roads.	Qb: 28: 2 clay, 7 silt, 42 sand, 15 granules, 33 pebbles, 0 cobbles, --- liquid limit, --- plastic limit, --- plasticity index; 29: 2, 5, 13, 17, 61, 2, none, 14?, none
Qgf	Glaciofluvial deposits	Sand, silt, and gravel; very micaceous. Yellowish-gray (5 Y 7/2), to light orange brown (5 YR 7/4). As much as 70 feet thick but generally 30 feet thick. Local foreset bedding and crossbedding. Beds from 1 inch to 1 foot thick. Well sorted; poorly compacted. Some interfingering with lake deposits.	Deposited in glacial lake by Scantic River. Material derived mainly from eastern highlands.	Good surface drainage; high to low permeability depending on percent of silt present.	Very easy with hand tools and power machinery.	Fair, slopes soon slump and ravel to the angle of repose for sand (30° to 35°).	Good. Stable.	Low	High	SM SP	Source of fill. Makes fair subbase for roads.	Qgf: 7: 1 clay, 22 silt, 76 sand, 1 granules, --- pebbles; 38: 0, 2, 98, 0, 0; 39: 0, 1, 94, 1, 4
Ql	Lake deposits	Paired silt and clay layers, generally silt and sand near top of unit. Silty layers are pale yellowish-brown (10 YR 6/2) when dry. Clay layers are grayish brown (5 YR 4/2) or yellowish-gray (5 Y 7/2). As much as 150 feet thick but average 30 feet. Most varves less than 1/2 inch thick, and of wide extent. Very well sorted and well compacted. Disc-shaped concretions (Tarr, 1935) scattered throughout the unit. Conformably overlain by deltaic and lake deposits.	Silt, clay, and sand layers deposited as seasonal pairs in glacial lakes. (Flint, 1957, p. 294).	Poor drainage. Lateral permeability, very low along clay layers but higher along silty and sandy layers. Virtually no downward permeability.	Easy to difficult to excavate. Cuts 15 to 20 feet high will stand unsupported but slumping can be expected in wet areas. Wet plastic clay is difficult to handle.	Fair; will slump (see landslide deposits above). Recommended slope 15° to 20°.	Fair to poor; spread footings necessary. (See Legget and Bartley, 1953).	High	Moderate	MH CH ML	Source of brick clays. (See Loughlin, 1905, p. 11.) Poor subbase for surfaced roads. Unsurfaced roads may be impassable [5] when wet.	Ql: 11: 57 clay, 43 silt, 0 sand, 30 liquid limit, 25 plastic limit, 5 plasticity index; 14: 79, 15, 6, 54, 30, 24; 45: 25, 57, 18, 29, 26, 3
Qt	Till	Unsorted and nonstratified silt, sand, clay, cobbles, and boulders. Reddish-brown (10 R 4/4) or pale grayish red (10 R 5/4). Generally 20 feet thick but locally exceeds 60 feet. Locally called hardpan or boulder clay. Upper few feet generally loose; compact and tough at depth. Forms a thin veneer on bedrock in western and eastern parts of quadrangle and streamlined hills (drumlins) in rest of quadrangle. Underlies younger deposits in most of quadrangle. Contains lenses of varved clay and coarser stratified drift.	Deposits of the debris acquired by ice sheet as it moved over the land.	Loose till is well to poorly drained and permeability is moderate. Compact till is well drained but has low permeability.	Difficult with hand tools; can be handled with some difficulty by power machinery. Horizontal fissility lends to ripping. Large boulders may require special handling or use of explosives.	Stands well in vertical cuts. Recommended slope 150 to 30°.	Good; stands in cuts more than 20 feet high. Easily compacted to make good fill.	Low unless saturated.	Low to moderate.	SC CL ML SW SM	Can be used as fill. Locally could be used to make impervious fill. Poor subbase for hard-surfaced roads; unsurfaced roads may be impassable [5] when wet.	Qt: 1: 5 clay, 22 silt, 58 sand, 5 granules, 10 pebbles, 0 cobbles, --- liquid limit, --- plastic limit, --- plasticity index; 3: 6, 24, 26, 4, 40, 2, 18, 17, 1; 15: 4, 16, 38, 8, 34, 0, ---, ---, ---; 25: 6, 30, 40, 2, 22, 0, ---, ---, ---; 26: 4, 14, 32, 1, 35, 14, ---, ---, ---
Trp	Portland arkose	Chiefly reddish-brown to grayish-red fine-grained sandstone, siltstone, shale and conglomerate. Individual grains are angular to subangular and decrease in size from east to west. Hartshorn and Koteff (1967) found major constituents to be: strained quartz 30-65 percent; microcline and plagioclase, 20 to 40 percent; ferruginous clay, 10-50 percent; and mica, 1-15 percent. Accessory minerals include: hematite, magnetite, ilmenite, chlorite, epidote, apatite, zircon, tourmaline, garnet, and calcite. Calcite appears to be of secondary origin and the magnetite is in part altered to hematite. Sandstone and siltstone generally irregularly thin bedded being 1-3 feet thick. At least 12,000 feet of arkose is inferred to underlie the quadrangle.	Deposited by streams carrying debris from eastern crystalline highlands into ancestral Triassic Conn. Valley depositional basin.	Permeability low to moderate depending in on cementation and spacing of joints and faults.	Generally drilled and blasted without difficulty. Where well bedded can sometimes be bulldozed or ripped off. Overbreak and rock loads moderate to high. Rocks loads excessive in wet zones. Wet squeezing ground in major fault zones. Shales slake in air. Weight = 156-165 lbs. per cubic ft.	Stands well in vertical cuts. Arkose and conglomerate both weather to light gray to dark brown; finer beds disintegrate into red clay, silt and sand.	Good; compressive strength low to high.	Low - frost wedging occurs along joints and faults.	Low		Formerly used as building or dimension stone; sandstone and conglomerate could be used as riprap; shale is used in manufacture of bricks.	No test data.

[1] For buildings generally less than four stories high. Characteristics may differ somewhat for higher buildings.

[2] Corps of Engineers, U.S. Army, Technical Memorandum No. 3-357, v. 1, March 1953.

[3] Analyses by T. C. Nichols and Jean M. Roach, U.S. Geological
Physical properties of samples taken from different parts of these geologic units may differ materially from those reported here. Grain size after Wentworth, C. K., 19__, A scale of grade and class terms for clastic sediments: Jour. Geol., v. 30, p. 377-39__.

[4] Colors of dry samples according to Goddard and others, 1948, Rock Color Chart, National Research Council, Washington, D. C.

[5] For two-wheeled drive vehicles.

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